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COMMERCIAL FERTILIZER FOR THE TENTH DISTRICT

The adoption of new techniques of production has changed the nature of the farm business considerably in recent years. Better mechanical equipment, hybrid seeds, and improved herbicides and insecticides all are examples of these new technologies. Although commercial fertilizer has been used for centuries in some parts of the world and for many decades in sections of the United States, only recently has it been used widely in the Tenth District. It must be considered a new technology in this District and, as such, carries with it all of the uncertainties associated with that which is new.

These new techniques of production have important implications to people interested in agricultural credit. In general, the effect of these innovations has been to increase the amount of short-term and intermediate-term credit that is needed in relation to long-term credit. The availability of short-term and intermediate-term credit may determine whether these new techniques will be adopted. As a result, an examination of some problems and possibilities of fertilizer application, as well as the extent to which the practice is being carried on, is appropriate.

Fertilizer Use The increase in fertilizer use in the Tenth District has been substantial. A large part of the fertilizer tonnage is used in the eastern portion of the District and in the irrigated sections farther west. In certain areas where rainfall is a limiting factor, sufficient response from fertilizer application has not been realized to make it profitable. From 1935 to 1951, Missouri, followed by Kansas and Oklahoma, had the greatest tonnage increase. Since rainfall is higher in Missouri than in other Tenth District states, fertilizer has been used extensively there longer than in the other states of the District.

As time passes and land is cropped without returning the nutrients which are removed, the soil fertility problem becomes more and more serious. This is the underlying reason for the application of fertilizer and explains why crops in many areas now respond favorably to the use of fertilizer. It can be expected that crops will show a greater response to the use of fertilizer as soil nutrients become more deficient. This long-time trend, together with the temporary influences discussed subsequently, explains the large increase in the use of fertilizer in the Tenth District, as shown in Table 1. Increased knowledge of the possibilities of fertilizer usage, favorable moisture conditions in recent years, lack of a satisfactory legume for much of the area, favorable commodity prices in relation to fertilizer prices, and the emphasis given to soil conservation programs, all appear to be partially responsible for the recent increase in the use of fertilizer.

Experimentation and extension work in recent years have increased knowledge of results that can be attained by proper application of fertilizer. In addition, a time lag usually exists between the time an innovation is introduced into a community by the first farmer and the time it is widely accepted. Many farmers must observe the results of the use of a new technique on another farm before adopting the new method. But this is not the only reason for increased consumption of fertilizer, since the essential information about fertilizer has long been known by agronomists and advocated by extension personnel.

An important factor responsible for the increase probably has been the favorable moisture conditions of the last decade. In a large part of the Tenth District, crops do not respond to fertilizer application under average rainfall conditions. With above average rainfall, there probably has been above aver-

Table 1. COMMERCIAL FERTILIZER CONSUMPTION BY TENTH DISTRICT STATES AND THE UNITED STATES, 1935-1939, AND BY YEARS, 1940-1951

(Short tons in thousands)

Area	Fertilizer Consumption												
	Average 1935-39	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951
Colorado	3	6	6	8	9	11	18	24	37	36	31	38	50
Kansas	13	18	88	27	32	47	38	61	117	116	127	148	162
Missouri	75	93	97	120	150	180	193	302	268	423	455	366	465
Nebraska	1	2	2	2	2	3	3	9	35	40	33	47	78
New Mexico	2	2	4	4	4	7	8	15	11	13	14	13	20
Oklahoma	7	8	13	15	25	24	31	59	84	121	126	144	152
Wyoming	2	2	2	2	2	4	4	5	5	5	6	7	7
Tenth District	102	131	146	179	224	275	296	475	556	754	791	762	933
United States	7,338	8,249	9,183	9,949	11,463	12,055	13,202	14,892	15,039	15,980	16,449	17,984	18,666

SOURCE: Fertilizer Review, April-May-June, 1952, p. 8; April-May-June, 1951, p. 10; May-June, 1947, pp. 14, 15.

age crop response to fertilizer. This should not be interpreted to mean that there has been an overextension in the use of fertilizer, and that it will cease to be a profitable practice with normal rainfall. On the contrary, it means that above average rainfall probably has hastened the adoption of the use of fertilizer in the eastern part of the Tenth District.

Another factor that may have influenced nitrogen fertilizer use in the Tenth District is the lack of a dry-land legume for the area. Legumes have a faculty for extracting nitrogen from the air and depositing it in the soil. When a legume is present in the crop rotation, there is less need for nitrogen fertilizer. This probably is a minor consideration, but it may be a partial explanation of the recent increase in fertilizer usage.

One of the most important reasons for the increase has been the change in relative prices of agricultural products and fertilizer. Table 2 indicates that corn and wheat prices have increased much more rapidly than fertilizer prices. These relative price changes have encouraged the use of fertilizer. Table 2 also indicates that the price of fertilizer has increased less than the price of certain other items such as seeds, machinery, and labor. Within limits, it is possible to substitute fertilizer for certain other inputs in crop production. Such substitution would be encouraged by the relative price changes in recent years.

Table 2. INDEX OF PRICES RECEIVED AND PRICES PAID BY FARMERS FOR SELECTED ITEMS, 1935-51

(1935-39=100)

Year	Prices Paid				Prices Received	
	Farm Machinery	Wage Rates	Seed	Fertilizer	Corn	Wheat
1935	97	88	105	102	112	102
1936	98	94	93	97	111	126
1937	100	107	130	101	137	119
1938	103	107	94	100	71	69
1939	102	105	78	100	69	85
1940	100	107	86	96	85	83
1941	101	125	82	96	93	116
1942	107	163	111	107	115	136
1943	111	217	139	114	149	167
1944	114	263	158	116	164	174
1945	115	297	162	118	159	184
1946	119	320	167	119	204	235
1947	135	346	192	131	270	283
1948	157	365	223	143	272	246
1949	176	354	202	147	169	232
1950	180	352	194	141	193	247
1951	194	388	197	149	235	260

SOURCE: Prices paid from Farm Cost Situation, USDA, October, 1952, p. 2. Prices received from Wheat Situation, USDA, July, 1952, p. 2, and from Agricultural Outlook Charts, 1952, USDA, p. 48.

Government soil conservation programs have encouraged fertilizer consumption. The application of fertilizer frequently is essential in establishing the grasses and legumes that are necessary for soil conservation. Soil Conservation Service programs have encouraged fertilizer usage through education and technical assistance, and the Production and Marketing Administration has paid part of the cost of fertilizer when used for certain conservation practices.

The above factors, and possibly others which may have been overlooked, have combined to cause the rapid increase in fertilizer consumption in recent years. The remainder of this report will be directed toward evaluating the profitability of applying different quantities and kinds of fertilizer to certain crops at different locations.

Kinds of Fertilizer Strictly defined, fertilizer includes all materials that are added to the soil to aid in producing crops. According to this meaning, barnyard manure and crop residues would be classified as fertilizers. In this report, however, only commercial fertilizer will be discussed. This includes any material containing one or more of the common fertilizer elements—nitrogen, phosphorus, and potassium—which is sold to increase crop production. Other elements, of minor importance, which may be classified as commercial fertilizer are iron, sulfur, boron, copper, calcium, and manganese.

Nitrogen and phosphorus fertilizers are of greatest importance in the Tenth District because most of the soils of the area are well supplied with potash. Reference to Table 3 will show the percentage distribution of use of the various fertilizer elements. The use of potash is relatively unimportant, except

in Missouri and Oklahoma. Only in Nebraska is nitrogen used in greater amounts than phosphoric acid. When the Tenth District is compared with the entire United States, relatively more phosphoric acid and relatively less potash is used in the Tenth District than is used nationally.

Fertilizer Carriers There are many organic and inorganic carriers of nitrogen, phosphorus, and potassium. In general, the carrier has no effect on the quality of the fertilizer. An exception must be made in the case of rock phosphate, which does not appear to be as effective as other types of phosphate fertilizer carriers when applied to nonlegumes. Since the most highly concentrated fertilizers represent less bulk per pound of available plant nutrient, one carrier may be easier to handle than another.

When the cost of fertilizer carriers is compared, it is important to consider the cost per pound of the available plant nutrient in which the individual is interested. The per cent of the total fertilizer poundage represented by the various nutrients is the crucial figure. Available nitrogen, phosphoric acid, and potassium usually are expressed in that order in fertilizer formulas. For example, triple superphosphate is written as 0-45-0. This means there is the equivalent of 45 pounds of available phosphoric acid for every 100 pounds of fertilizer. There would be no nitrogen or potassium in such a fertilizer. Normal superphosphate usually is expressed as 0-18-0 or 0-20-0. In comparing the cost of triple superphosphate and normal superphosphate, one should calculate the cost per pound of available phosphoric acid for each of the fertilizers. Since a more bulky fertilizer usually costs more to apply, an individual may be willing to pay a slight premium for triple superphosphate. A simple method of comparing the cost per pound is to divide the price per ton by the pounds of available phosphoric acid in the materials. The fertilizer giving the lower figure is the more economical. For example, the current price for normal superphosphate (0-20-0) in the Tenth District is approximately $39.90 per ton. A comparable price for triple superphosphate (0-45-0) is $78.10. If $39.90 is divided by 400 pounds (20 per cent of 2,000 pounds), a cost of $.10 per pound of available phosphoric acid is obtained. In a similar fashion, when $78.10 is divided by 900 pounds (45 per cent of 2,000 pounds), the cost is $.087 per pound. Clearly the triple superphosphate is a better buy when these prices prevail.

Table 3. PERCENTAGE DISTRIBUTION OF USAGE OF COMMON AVAILABLE FERTILIZER NUTRIENTS IN TENTH DISTRICT STATES AND THE UNITED STATES FOR THE YEAR ENDING JUNE 30, 1951[1]

Area	Distribution of Usage		
	Nitrogen (Per cent)	Phosphoric Acid[2] (Per cent)	Potash (Per cent)
Colorado	35.6	58.3	6.1
Kansas	26.3	69.5	4.2
Missouri	21.7	50.4	27.9
Nebraska	57.8	40.6	1.6
New Mexico	30.8	67.8	1.4
Oklahoma	18.6	66.4	15.0
Wyoming	8.4	89.9	1.7
Tenth District	26.2	56.7	17.1
United States	25.5	45.4	29.1

[1] Includes Government distribution.
[2] Includes 2 per cent of the colloidal phosphate and 3 per cent of the phosphate rock marketed for direct application.
SOURCE: Calculated from **Agricultural Chemicals**, Volume 7, Number 6, June, 1952, p. 40.

Crop Response Data will be presented in the following sections indicating crop response to fertilizer usage for selected crops at certain locations in the Tenth District. These data may or may not apply to a particular farm or soil in the District. Rather, they should be used as an indication of the response obtained under controlled experimentation.

The individual who is contemplating using fertilizer should have his soil tested for nutrient deficiency and then should examine fertilizer response data for his area if it is available. The State Agricultural Experiment Stations in the Tenth District have experimental data available on crop response to fertilizer application for many of the soils of the District. The data which follow are presented not only to give an indication of the yield response, but also to illustrate a method for calculating the profitability of a practice such as the use of fertilizer.

In the analysis which follows, it was necessary to use some price and cost relationship. Government support prices for 1952 on wheat, corn, and cotton were used. These prices are believed to be realistic planning prices for the coming year. Current fertilizer prices were used in calculating fertilizer cost.

Wheat Response The response of wheat to nitrogen at Manhattan, Kansas, is shown in Table 4. The additional yield obtained by increasing the amount of nitrogen applied has been calculated by subtracting the yield of one application from the yield of the next heavier application. For example, when 50 pounds of nitrogen were applied instead of 25 pounds, an additional yield of 3.1 bushels per acre was obtained. The additional dollar return and the additional cost also were computed. As long as the additional return is greater than the additional cost, fertilizer should be applied. At Manhattan, the additional return from 50 pounds of fertilizer was greater than the additional cost, but the additional cost in moving from 50 to 100 pounds was greater than the additional return. For the period

covered and using the assumed prices, an application of more than 50 pounds and less than 100 pounds would have been most profitable. Because these are Government support prices and current costs, they favor heavy fertilizer application. It should be pointed out that only fertilizer cost is included in the last column. There would, of course, be additional labor and machine use associated with additional fertilizer application. This point will be treated later in more detail.

Care should be exercised in the interpretation of Table 5. The additional yields probably are caused not only by the application of phosphoric acid but also by its being used in combination with nitrogen. In other words, yield responses of this order probably would not result from the application of phosphoric acid alone. The importance of using a balanced fertilizer should be stressed in this connection. As soils become older and are more intensively cropped, they may become deficient in more than one nutrient. When this happens, fertilizer elements such as phosphorus and nitrogen, when used in combination, frequently will cause a response that cannot be entirely attributed to either. A soil test, such as those made by state experiment stations or extension services for a small fee, will determine a soil's fertility level.

The profitability of the use of phosphoric acid is shown in Table 5. When phosphoric acid was applied both with and without nitrogen, additional returns were greater than additional costs. Therefore, it can be concluded that the application of more than 50 pounds of both nitrogen and phosphoric acid would have been profitable during the 1948 to 1952 period. Potash failed to show a yield response at Manhattan and was not included in the analysis.

Table 4. PROFITABILITY OF USING NITROGEN ON WHEAT AT MANHATTAN, KANSAS, 1948-52

Available Nitrogen Per Acre (Pounds)	Average Yield Per Acre (Bushels)	Additional Yield Per Acre (Bushels)	Additional Return Per Acre[1] (Yield X Price)	Additional Cost Per Acre[2]
0	29.9	—	$ —	$ —
25	32.3	2.4	5.28	3.38
50	35.4	3.1	6.82	3.38
100	36.3	.9	1.98	6.76

[1] Wheat, $2.20 per bushel.
[2] Nitrogen, $.135 per pound.
SOURCE: Calculated from the proceedings of annual meetings of the National Joint Committee on Fertilizer Application, 1948-51; 1952 data supplied by the Kansas Agricultural Experiment Station, Manhattan, Kansas.

Table 5. PROFITABILITY OF USING PHOSPHORIC ACID ON WHEAT AT MANHATTAN, KANSAS, 1948-52

Available Nitrogen & Phosphoric Acid Per Acre (Pounds)	Average Yield Per Acre (Bushels)	Additional Yield Per Acre (Bushels)	Additional Return Per Acre[1] (Yield X Price)	Additional Cost Per Acre[2]
25 - 0	32.3	—	$ —	$ —
25 - 50	37.7	5.4	11.88	5.00
50 - 0	35.4	—	—	—
50 - 50	44.6	9.2	20.24	5.00

[1] Wheat, $2.20 per bushel.
[2] Phosphoric acid, $.10 per pound.
SOURCE: Calculated from the proceedings of annual meetings of the National Joint Committee on Fertilizer Application, 1948-51; 1952 data supplied by the Kansas Agricultural Experiment Station, Manhattan, Kansas.

Table 6. PROFITABILITY OF USING NITROGEN ON WHEAT AT BELLEVILLE, KANSAS, 1948-52

Available Nitrogen Per Acre (Pounds)	Average Yield Per Acre (Bushels)	Additional Yield Per Acre (Bushels)	Additional Return Per Acre[1] (Yield X Price)	Additional Cost Per Acre[2]
0	22.8	—	$ —	$ —
25	28.9	6.1	13.42	3.38
50	30.8	1.9	4.18	3.38
100	32.1	1.3	2.86	6.76

[1] Wheat, $2.20 per bushel.
[2] Nitrogen, $.135 per pound.
SOURCE: Calculated from the proceedings of annual meetings of the National Joint Committee on Fertilizer Application, 1948-51; 1952 data supplied by the Kansas Agricultural Experiment Station, Manhattan, Kansas.

Table 7. PROFITABILITY OF USING PHOSPHORIC ACID ON WHEAT AT BELLEVILLE, KANSAS, 1948-52

Available Nitrogen & Phosphoric Acid Per Acre (Pounds)	Average Yield Per Acre (Bushels)	Additional Yield Per Acre (Bushels)	Additional Return Per Acre[1] (Yield X Price)	Additional Cost Per Acre[2]
25 - 0	28.9	—	$ —	$ —
25 - 50	24.6	–4.3	–9.46	5.00
50 - 0	30.8	—	—	—
50 - 50	31.9	1.1	2.42	5.00

[1] Wheat, $2.20 per bushel.
[2] Phosphoric acid, $.10 per pound.
SOURCE: Calculated from the proceedings of annual meetings of the National Joint Committee on Fertilizer Application, 1948-51; 1952 data supplied by the Kansas Agricultural Experiment Station, Manhattan, Kansas.

Similar data and analyses are presented for Belleville, Kansas, in Tables 6 and 7. Wheat failed to respond as significantly to fertilizer application as at Manhattan. This probably can be explained by the smaller amount of rainfall received at Belleville. On the other hand, 50 pounds of nitrogen would have been profitable at Belleville, but the application of phosphoric acid, which is indicated by Table 7, would not have been profitable. In fact, Table 7 shows a negative response to the application of phosphoric acid. Potash did not show sufficient response to enter into the analysis.

Corn Response Corn is an important crop in the eastern part of the Tenth District and in some of the irrigated sections farther west. Data have been collected showing the response of corn to the application of fertilizer in some of the Tenth District states. Table 8 shows part of these data for eastern Nebraska. The data indicate that more than 80 pounds of nitrogen would have been a profitable application during the years in question

Table 8. PROFITABILITY OF USING NITROGEN ON CORN IN EASTERN NEBRASKA, 1946-50

Available Nitrogen Per Acre (Pounds)	Average Yield Per Acre (Bushels)	Additional Yield Per Acre (Bushels)	Additional Return Per Acre[1] (Yield X Price)	Additional Cost Per Acre[2]
0	54	—	$ —	$ —
40	69	15	24.00	5.40
80	73	4	6.40	5.40

[1] Corn, $1.60 per bushel.
[2] Nitrogen, $.135 per pound.

SOURCE: Calculated from Commercial Fertilizers for Corn in Central and Eastern Nebraska. G. W. Lowery and H. F. Rhoades, Outstate Testing Circular 14, University of Nebraska Agricultural Experiment Station, Lincoln, Nebraska.

Table 9. PROFITABILITY OF USING NITROGEN ON CORN IN EASTERN OKLAHOMA, 1948-50[1]

Available Nitrogen Per Acre (Pounds)	Average Yield Per Acre (Bushels)	Additional Yield Per Acre (Bushels)	Additional Return Per Acre[2] (Yield X Price)	Additional Cost Per Acre[3]
0	38.1	—	$ —	$ —
16	46.5	8.4	13.44	2.16
32	52.1	5.6	8.96	2.16
48	54.3	2.2	3.52	2.16

[1] Atoka, Craig, Creek, Garvin, Johnston, Lincoln, McIntosh, Muskogee, Mayes, Osage, Ottawa, Okmulgee, Pawnee, Pontotoc, Seminole, and Wagoner counties.
[2] Corn, $1.60 per bushel.
[3] Nitrogen, $.135 per pound.

SOURCE: Calculated from unpublished data from the Department of Agronomy, Oklahoma Agricultural Experiment Station, Stillwater, Oklahoma.

when the assumed prices were used. It should be borne in mind, however, that the tests cover a relatively short period and that the prices used are quite favorable to the use of fertilizer.

Experimental data for Kansas and Nebraska show little response by corn to phosphoric acid and potash. Their application is not recommended unless a deficiency definitely has been established.

Table 9 presents the results of the application of nitrogen to corn in eastern Oklahoma. The data indicate that somewhat more than 48 pounds of nitrogen would have been an economical application with the price relationships used. These data show a definite response by corn to the application of nitrogen in Oklahoma.

Cotton Response A scarcity of data exists showing the response of cotton to the application of fertilizer in the Tenth District. The Oklahoma Agricultural Experiment Station has a number of experiments underway that will provide additional facts. This information, however, is not yet available. Table 10 is presented to show the results of research conducted sometime ago in Oklahoma. According to these data, the additional return from 28.8 pounds of available phosphoric acid is much greater than the additional cost. Since that time, however, cotton production has tended to shift from the eastern to the western part of Oklahoma.

Table 10. PROFITABILITY OF USING PHOSPHORIC ACID ON COTTON IN EASTERN OKLAHOMA, 1925-28[1]

	Seed Cotton		Lint Cotton		
Available Phosphoric Acid (Pounds)	Average Yield Per Acre (Pounds)	Add'l Yield Per Acre (Pounds)	Add'l Yield Per Acre[2] (Pounds)	Add'l Return Per Acre[3] (Yield X Price)	Add'l Cost Per Acre[4]
0	745	—	—	$ —	$ —
28.8	867	122	40.6	12.59	2.88

[1] Pottawatomie, Haskell, Logan, McClain, Carter, Payne, Creek, Lincoln, Okfuskee, Okmulgee, McIntosh, and Muskogee counties.
[2] Assuming seed cotton ginning one third lint cotton.
[3] Cotton, $.31 per pound.
[4] Available phosphoric acid, $.10 per pound.

SOURCE: Calculated from unpublished data from the Department of Agronomy, Oklahoma Agricultural Experiment Station, Stillwater, Oklahoma.

Variability of Returns When a new technique is made available to producers, a certain amount of risk is involved. In the case of fertilizer, this risk stems from two sources. The individual producer is never certain that results which have been obtained elsewhere will apply to his particular farm. In addition, the variability of rainfall in the Tenth District causes the response from fertilizer application to change from one year to the next.

An attempt has been made to measure this variability for wheat production data obtained at Manhattan, Kansas. Data are available that indicate the response of wheat to fertilizer application since 1915. Although the fertilizer application was conservative, there was sufficient response to make its use profitable when the assumed prices were used. The average net return line in Table 11 shows that the addition of each fertilizer nutrient increased average profit. Table 11 makes it evident that the application of fertilizer increased the range of net returns. The frequency distribution of net returns also is considerable at all three levels of fertilizer application. However, when the complete fertilizer was ap-

Table 11. FREQUENCY DISTRIBUTION OF FERTILIZER RETURNS LESS FERTILIZER COST FOR WHEAT AT MANHATTAN, KANSAS, 1915-51[1]

	Frequency of Net Returns on Plots Treated With:		
Net Returns Per Acre[2]	Available Phosphoric Acid	Available Phosphoric Acid and Potassium	Available Phosphoric Acid, Potassium and Nitrogen
$-21 to -30	1	1	—
-11 to -20	3	—	—
-1 to -10	11	5	4
0 to 10	13	19	12
11 to 20	8	10	13
21 to 30	1	1	4
31 to 40	—	1	4
Average Net Return	$2.53	$6.69	$14.00
Range	$-23.82 to $29.64	$-25.92 to $33.26	$-4.90 to $35.71

[1] 16 pounds of phosphoric acid, 20 pounds of potassium, and 13 pounds of nitrogen.
[2] Wheat, $2.20 per bushel; phosphoric acid, $.10 per pound; postassium, $.05 per pound; and nitrogen, $.135 per pound.

SOURCE: Calculated from unpublished data supplied by the Kansas Agricultural Experiment Station, Manhattan, Kansas.

plied, the returns failed to more than cover the cost in only four years. The choice, then, is between a practice that is clearly profitable and one which definitely increases the variability of income.

Rainfall and Fertilizer Use In the Tenth District, one of the factors that limits fertilizer usage is the lack of rainfall in many areas. There is evidence, however, which indicates that fertilizer may be used farther west than is commonly supposed. H. F. Murphy, Head of the Department of Agronomy, Oklahoma Agricultural and Mechanical College, states that wheat will show a definite response to nitrogen application when annual rainfall is 25 inches with normal distribution for the year.

When fertilizer is used under such conditions, it may be applied every year in the belief that an average profit will be shown, or it may be applied only in certain years when conditions appear favorable. When wheat is being produced, the application of nitrogen can be delayed until spring. It can then be applied if conditions are favorable. This practice reduces the risk of fertilizer application in an area where rainfall is highly variable. When corn or other row crops are grown, nitrogen application may be delayed until the crops are cultivated. In the case of wheat, delaying nitrogen application may involve an additional operation, since seeding and fertilizer application may be performed at the same time. The decision, then, becomes one of balancing the cost of an additional operation against the reduction in risk associated with delayed application.

Price Changes and Fertilizer Consumption Considerable interest has been shown recently in what would happen to fertilizer consumption if prices changed drastically. The answer depends on how much prices change, in what direction they change, and the present rate at which fertilizer is being applied. The relative prices of the crop produced and the fertilizer used determine the quantity of fertilizer to be used when the physical response of the crop to fertilizer is known.

Table 12. CHANGE IN THE QUANTITY OF FERTILIZER USED AS PRICES CHANGE

Available Nitrogen Per Acre	Average Yield Per Acre	Additional Yield Per Acre	Additional Revenue Per Acre: Corn at $1.60 per bu.	Additional Revenue Per Acre: Corn at $.75 per bu.	Additional Cost Per Acre: Nitrogen at $.135 per lb.
(Pounds)	(Bushels)	(Bushels)			
0	55.1	—	$ —	$ —	$ —
60	82.1	27.0	43.20	20.25	8.10
90	87.1	5.0	8.00	3.75	4.05
120	90.2	3.1	4.96	2.33	4.05
150	93.8	3.6	5.76	2.70	4.05
180	94.7	.9	1.44	.68	4.05

SOURCE: Calculated from irrigated corn yield data furnished by the Department of Agronomy, Oklahoma Agricultural Experiment Station, Stillwater, Oklahoma. Seminole, Pawnee, Bryan, Wagoner, and Muskogee counties.

To illustrate the above principle, data showing the response of irrigated corn to nitrogen for 1948, 1949, and 1950 in certain Oklahoma counties are presented in Table 12. In this area, when corn was $1.60 per bushel, it was profitable to apply between 150 and 180 pounds of nitrogen per acre, because somewhere in this range the additional cost becomes greater than the additional revenue. If the price of corn were to fall to $.75 per bushel, it would pay to apply between 60 and 90 pounds of nitrogen per acre. Thus, it may be seen that if the price of corn falls relative to the price of fertilizer, the application of fertilizer should be reduced.

This would be the reaction of the individual if he knew the response of crops to fertilizer, and if he knew the prices of corn and fertilizer. This is not the same as predicting that the quantity of fertilizer used will be reduced if prices in the future change in this direction. This would be the case if everyone was now using an optimum amount of fertilizer and if fertilizer cost did not decline. There is reason to believe, however, that many people are unaware of the possibilities of the use of fertilizer. These people may increase their consumption of fertilizer even if the price of corn or wheat does fall in relation to the price of the fertilizer. Even in times of depression, farmers and the people who loan them money should strive to apply economic quantities of fertilizer.

AGRICULTURAL AND BUSINESS CONDITIONS

AGRICULTURAL SITUATION

The index of prices received by farmers during the past few months has been lower than for any period since the outbreak of the Korean war. Farm costs have remained at high levels, while the index of prices received declined. This has resulted in the ratio of prices received to prices paid being less than 100 since October, 1952. Prior to this, the ratio had not been below 100 since June, 1950. Consequently, the price-cost ratio has been more unfavorable during the past three months than for any period since early in 1950.

Net income earned by American farmers during 1952, however, was maintained at near the previous

year's levels. The increased volume of agricultural production about offset the effect of declining prices and higher costs. As a group, farmers in Tenth District states fared better during 1952 than did the Nation's farmers. Crop production in the District was considerably better in 1952 than in 1951 and crop prices were maintained at rather favorable levels during the year. Increased cash receipts from crops not only offset decreased cash receipts from livestock but also caused cash receipts from all marketings to increase by 10 per cent in District states, compared with about 2 per cent for the Nation.

Conditions for seeding the winter wheat crop were quite unfavorable last fall throughout much of the Nation. They were particularly bad in large parts of the Tenth District. In spite of the unfavorable conditions for seeding the crop, farmers, both nationally and in the Tenth District, decreased the acreage planted last fall only 1 per cent from that planted in the fall of 1951. Although precipitation since October has been above normal for most of the District, the wheat crop remains in a precarious condition because of late emergence and inadequate subsoil moisture. According to the December forecast of the United States Department of Agriculture, winter wheat production in District states for 1953 was estimated at 281 million bushels, or only 47 per cent of production in 1952.

Total supplies of feed grains and other concentrates for the 1952-53 feeding season are nearly as large as for last season. However, the total quantity that will be consumed is expected to be less than last year because the reduction in hog production will more than offset prospective further expansion in cattle feeding. Consequently, supplies per animal unit are expected to be larger this season than last season. Total supplies of hay are about 3 per cent less than last season for the Nation. In relation to the increasing number of roughage-consuming animal units, hay supplies are about 6 per cent smaller than last year. In large parts of the Tenth District, pastures and ranges are much below average this winter. Furthermore, hay supplies are quite deficient and requirements are high, since pastures and ranges have been covered with snow throughout much of the area. As a result, forced liquidation of cattle numbers is continuing in parts of the District.

Meat production during the fall of 1952 increased more than usual and output from October to December was near record levels for the quarter. Declining meat animal prices during the summer and fall of 1952 are causing a sharp reduction in hog production. The pig crop report released by the Department of Agriculture in December indicates that farmers intend to produce 15 per cent fewer pigs in the spring of 1953 than were produced in the spring of 1952. However, record numbers of cattle on farms and in feed lots indicate that beef production during 1953 may be 15 per cent above that of 1952. Thus, total meat production in 1953 is expected to be about the same as last year. Per capita supplies will be somewhat less because of the increasing population.

MEMBER BANK CREDIT

Holdings of United States Government securities by Tenth District member banks declined 123 million dollars, or 5 per cent, from November 26 to December 31, 1952. Reserve city banks reported a reduction of 108 million dollars in holdings of these securities and country banks, a reduction of 15 million. Most of the total decline represented liquidation of Treasury bills as banks adjusted their portfolios in preparation for year-end condition statements. In addition to liquidating Treasury bills, District banks drew heavily on their reserves and virtually eliminated indebtedness at the Reserve Bank, as well as at other banks, on December 31. As a consequence, District member bank balances at the Reserve Bank dropped 72 million dollars between November 26 and December 31.

The reduction of Government security holdings at District member banks during December limited the increase in this class of assets to 99 million dollars for the year, compared with a rise of 157 million dollars in 1951. Portfolios of state, municipal, and corporate securities, on the other hand, increased 59 million dollars in 1952, compared with 11 million in the previous year. This change in the composition of security purchases was especially pronounced at District reserve city banks, where Treasury issues constituted only 58 per cent of net acquisitions in 1952, compared with 98 per cent in 1951.

Gross demand deposits expanded 142 million dollars, or 2 per cent, at District member banks during the five weeks which ended December 31. This increase reflects the seasonally large volume of checks in process of collection, as well as a net inflow of funds to the District during December. The inflow appears to be the result of net United States Treasury payments into the District, and a net inward flow of private payments, the latter undoubtedly weighted with bank sales of securities. Over the entire year, demand deposits increased 185 million dollars, or 3 per cent, compared with 394 million, or 7 per cent, in 1951.

Time deposit growth in the past year totaled 98 million dollars, the same as in 1951. In contrast to 1951, however, when the increase at reserve city and country banks was about equal, more than two thirds of the gain in 1952 occurred at country banks. The

SELECTED ITEMS OF CONDITION OF TENTH DISTRICT MEMBER BANKS
(In millions of dollars)

	All Member Banks			Reserve City Banks			Country Banks		
	Dec. 31 1952	Nov. 26 1952	Dec. 31 1951	Dec. 31 1952	Nov. 26 1952	Dec. 31 1951	Dec. 31 1952	Nov. 26 1952	Dec. 31 1951
Loans and investments	5,449	5,565	5,060	3,017	3,124	2,847	2,432	2,441	2,213
Loans and discounts	2,289	2,284	2,059	1,278	1,276	1,219	1,011	1,008	840
U. S. Government obligations	2,607	2,730	2,505	1,428	1,536	1,364	1,179	1,194	1,141
Other securities	553	551	496	311	312	264	242	239	232
Reserve with F. R. Bank	948	1,020	938	571	651	591	377	369	357
Balances with banks in U. S.	792	678	856	384	259	373	408	419	483
Cash items in process of collection	385	334	406	359	311	372	26	23	34
Gross demand deposits	6,341	6,199	6,156	3,696	3,554	3,591	2,645	2,645	2,565
Deposits of banks	1,037	1,006	1,097	964	933	1,011	73	73	86
Other demand deposits	5,304	5,193	5,059	2,732	2,621	2,580	2,572	2,572	2,479
Time deposits	880	865	782	441	434	411	439	431	371
Total deposits	7,221	7,064	6,938	4,137	3,988	4,002	3,084	3,076	2,936
Borrowings	1	167	7	0	151	4	1	16	3

rise at the latter was 18 per cent and at the former, 7 per cent.

Loan volume showed very little net change between November 26 and December 31, as reserve city and country banks together added only 5 million dollars in new loans. During the corresponding period of 1951, the increase was 23 million dollars. Considering the entire year, loans at District member banks increased 231 million dollars, or 11 per cent, compared with 136 million, or 7 per cent, in 1951. Approximately three quarters of the rise occurred at country banks, where Federally guaranteed loans on the 1952 wheat crop represented the chief element in the expansion.

DEPARTMENT STORE TRADE

Dollar volume of sales at reporting department stores in this District in December was 9 per cent larger than a year earlier, compared with a gain of only 2 per cent for the entire year 1952. Christmas trade was at a new peak and extensive post-Christmas clearances served to maintain sales in relatively large volume late in December and early in January, but sales by mid-January dropped somewhat under the level of a year earlier. Sales increased more than usual during December, and the seasonally adjusted index of daily average sales rose from 117 per cent of the 1947-49 average in November to 119 per cent in December. This level was appreciably above the average of 113 per cent for the year 1952 and was the highest point since the index of 132 per cent for January, 1951, the peak of the second post-Korean wave of scare buying.

Department store inventories declined by about the usual amount during December, and the seasonally adjusted index of stocks was unchanged for the third consecutive month at 124 per cent of the 1947-49 average. This retail value of merchandise on hand at the end of December was about 2 per cent higher than a year earlier, contrasted with an average decline of 6 per cent throughout 1952.

BANK DEBITS

	Dec. 1952	12 Mos. 1952	Change from '51 Dec.	Change from '51 12 Mos.
	(Thousand dollars)		(Per cent)	
Colorado				
Colo. Springs	58,980	670,883	+4	−3
Denver	872,111	9,159,309	+15	+2
Gr. Junction	21,426	225,636	+13	+7
Greeley	30,856	364,105	+5	+5
Pueblo	57,675	634,575	+8	0
Kansas				
Atchison	11,215	126,287	0	−3
Dodge City*	15,467	—	—	—
Emporia	13,065	142,345	−9	−10
Hutchinson	46,834	545,379	−11	+6
Independence	12,258	115,090	+20	+16
Kansas City	108,390	1,086,804	+13	+3
Lawrence	17,793	174,798	+23	+16
Manhattan	13,361	149,294	0	+8
Parsons	12,177	139,001	+4	+20
Pittsburg	16,446	168,334	+13	+6
Salina	39,457	477,536	−6	+1
Topeka	126,267	1,315,676	+17	+7
Wichita	375,626	4,285,994	+20	+19
Missouri				
Independence	16,260	175,874	+11	+14
Joplin	37,203	402,483	+9	+8
Kansas City	1,554,056	15,955,260	+13	+6
St. Joseph	123,262	1,334,888	+1	−4
Nebraska				
Fremont	22,817	250,293	+10	+1
Grand Island	34,883	391,802	+13	+5
Hastings	18,231	203,989	+19	+8
Lincoln	113,955	1,180,469	+15	+5
Omaha	686,044	7,726,246	+2	−1
New Mexico				
Albuquerque	146,863	1,731,522	+21	+15
Santa Fe	36,453	407,796	+10	0
Oklahoma				
Bartlesville	223,031	2,379,032	+15	+12
Enid	40,127	473,549	−4	+6
Guthrie	5,178	62,550	+15	+11
Lawton	23,033	257,724	+5	+13
Muskogee	33,215	359,187	−16	+2
Norman	10,486	110,928	+20	+11
Oklahoma City	471,509	5,092,590	+13	+6
Okmulgee	8,589	93,196	−9	+3
Ponca City	26,158	281,086	+5	+7
Tulsa	847,957	8,316,072	+9	+7
Wyoming				
Casper	53,704	556,640	+17	+19
Cheyenne	38,982	475,696	+7	+6
District, 40 cities	6,405,933	67,999,918	+11	+5
U. S., 342 cities	170,648,000	1,692,098,000	+18	+7

*Not included in totals; new reporting center beginning May, 1952.

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